National Carbon Capture Center: Building a Successful Test Collaboration

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NATIONAL CARBON CAPTURE CENTER

National Carbon Capture Center

- **Sponsors:** U.S. Department of Energy and its National Energy Technology Laboratory
  - DOE's primary carbon capture research facility since 2009
- **Partners:** Electric Power Research Institute, power/energy industry leaders
- **Managed/operated by:** Southern Company
- **Location:** Wilsonville, Alabama
- **Infrastructure:** Real-world power plant operating conditions – coal and natural gas
- **Expertise:** Technical staff for design, installation, testing support and analysis
- **International collaboration:** Co-founder of International Test Center Network

Test Centers – Evolving Goals

- Cost-effective host site for moving carbon capture development from lab to industrial setting
- Knowledge sharing of public information
- Contribute to partnerships for commercial technology development
- Support Deployment
  - Provide scale-up information
  - Cost-effective testing of novel ideas to improve commercial process
- Support Net Negative Carbon Goals
  - Support transition - fossil fuel use to low or zero carbon options (flexible operation, high capture rate)
  - CO2 utilization and Direct Air Capture at the NCCC

NCCC

Pilot-Scale

Bench-Scale

Lab-Scale

Major Accomplishments and Future Scope

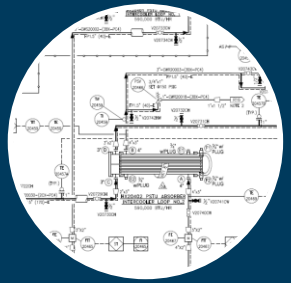
- 123,000+ hours of testing over last decade
- 68+ technologies tested / 40+ developers from 7 countries
- Post-combustion accomplishments:
  - ✓ Continuous expansion – alternative regeneration, gas injection, analytical support
  - ✓ Advanced solvents, membranes, solid sorbents
    - 18 technologies in queue to test / 8 technologies scaled up (or ready) to 10+ MW
- Natural gas expansion – first run completed Q1 2021
- Added CO2 Utilization and DAC development to scope

Oct. 1, 2020 – 5-Year Agreement Renewal / $140 Million
Expanding scope to CO_2 capture for natural gas power, CO_2 utilization, direct air capture

Project Development and Implementation

Safety First

Contract
- Screening
- NDA/TCA
- Onboarding



Project Scope
- Process
- Modification
- Integration

Design
- Mechanical
- Instrument
- Control
- Electrical
- Civil

Construction
- Foundation
- Flue Gas
- Utilities
- Installation
- Interconnection

O&M
- Operate
- Test Support
- Analysis
- Troubleshoot
- Repair

CO_2 Utilization Technology Development

- CO_2 conversion to biomass via agriculture/aquaculture
- Synthesis of fuels and organic chemicals
- Conversion of CO_2 to inorganic products, i.e., construction materials
- Synthesis of inorganic materials and chemicals
- CO_2 as working fluid for EOR and as solvents and refrigerants

Preferred host site for DOE funding opportunities

Southern Research	CarbonBuilt / UCLA (Carbon XPRIZE Winner)	Helios-NRG
Ethylene production using coal-fired flue gas	CO_2 mineralization to produce concrete	Algae technology to utilize CO_2 for value-added products

Carbon Utilization R&D Program Objectives

- **Reduce CAPEX and OPEX of known technologies**
  - Improve process integration with host site
  - More efficient CO_2 conversion vs. conventional manufacturing approaches
- **Identify technology opportunities and testing**
  - CO_2 conversion to biomass via agriculture /aquaculture
  - Synthesis of fuels and organic chemicals
  - Conversion of CO_2 to inorganic products
  - CO_2 as working fluid for EOR, as solvents / refrigerants
- **Leverage preferred DOE host site designation**
  - Cooperative agreements / FOA inclusion
  - Investigate options for pairing technologies (natural systems, customers, etc.)

Current/Upcoming Projects at NCCC

✓ CO_2 mineralization to produce concrete

✓ Ethylene production using coal-fired flue gas

✓ Algae technology to utilize CO_2 for value-added products

NCCC International Collaboration

- Support DOE goal of international cooperation
- Broad effort in China, India, Middle East, South Korea, Japan, EU, Australia, Canada, Norway
- Multiple paths for NCCC involvement
  - Partners, developers, network members, consulting services and workshops
- ITCN shares knowledge on operating test facilities
- One technical focus are per year
  - Analytical techniques
  - Amine carry-over
  - Support of CCSI
  - Open access technology
  - Alternative baselines to MEA

CSIRO Test Facility
Australia

CERI Joins ITCN
Beijing

Conclusions

- **Collaboration is essential**
  - NCCC has extensive experience taking projects from fundamental development into an industrial setting
- **CCUS R&D goals are evolving**
- **Small test facilities are needed**
  - Introduce low TRL technology
  - Cost-effective testing of advanced concepts for high TRL

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